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ABSTRACT

This paper discusses what is known about learning to date by emphasizing "connections" as necessary for learning. Knowledge about these connections can be placed into four categories: (1) neurological connections; (2) cognitive connections; (3) social connections; and (4) experiential connections. In terms of neurological connections, sensory input is crucial for newborns, but as long as the brain continues to be stimulated, our brains continue to make connections. Regarding cognitive connections, it has become apparent that people's minds think and understand things in terms of schemata. Therefore, it is easier to learn more complex concepts that fit into existing schemata than it is to learn something completely new. Deeper learning gets placed into schemata with time. Cognitive strategies can be broken down into cognitive learning and metacognitive strategies. These strategies are broken down and detailed in the document. Social connections refer to the interaction between the internal processes of the mind and how the mind grasps the external realities of knowledge. Making social connections between the various players at institutions of higher education may be an innovative strategy used in the near future. The last category is that of experiential connections, or making connections between experience and learning. Contains 28 references. (AMA)

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Learning Is About Making Connections

K. Patricia Cross

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Acknowledgment

The Educational Testing Service (ETS) has been a key partner in League projects and activities for over a decade. We are indebted to ETS for its generous contributions to the preparation and publication of this third paper in an annual series the League produces as "The Cross Papers." With support from ETS this paper will be distributed to thousands of community college leaders around the world.

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Foreword

Through its Learning Initiative the League for Innovation is leading the nation's community colleges–and increasingly two-year colleges around the world–in exploring new ideas and issues related to improving and expanding student learning. The Learning Initiative sponsors many activities: a special track at the League's annual *Innovations* conference, the Web-based *Technology and Learning Community* (www.league.org), several foundation-funded projects, *Learning Abstracts*, and a series of special monographs.

A key publication is *The Cross Papers*, prepared annually by League Senior Fellow K. Patricia Cross, which helps us focus our conversations on learning on the key issues and innovations in the community college. *Cross Papers* Number 1, *Developing Professional Fitness Through Classroom Assessment and Classroom Research* and Number 2, *Opening Windows on Learning*, have been distributed to thousands of community college faculty and administrators and are used as the basis for lively and substantive staff development programs in many institutions around the world.

The third Cross Paper, *Learning Is About Making Connections*, introduces her many readers to a pithy summary of some of the most complex information known about learning. With her knack for interpreting knotty concepts for the general reader, Cross cuts to the core and explains neurological connections, cognitive connections, social connections, and experiential connections in ways that will delight and inform the most jaded and cynical among us. Like the great teacher she is, Cross helps us make connections to the rich store of information embedded in these four key concepts. As a result, our own learning begins to expand–constructing new ideas, questions, and applications–and we hanker for more.

The League for Innovation in the Community College is honored to present this exceptional paper to our friends and colleagues around the world.

Terry O'Banion
President and CEO
League for Innovation in the Community College

LEARNING IS ABOUT MAKING CONNECTIONS

K. Patricia Cross

Hundreds of community colleges have been celebrating their silver anniversaries in the closing decades of this century, but the times ahead are at least as interesting and stimulating as the great growth period of the 1960s and 70s when so many community colleges were building campuses and launching new programs. The turn of the century will find many of the great founding administrators and faculty retiring, and many of us will look back upon their years with a touch of nostalgia about the high energy and commitment that characterized the building years.

But a different challenge awaits the new generation of community college educators, and it appears to be inspiring the familiar community college commitment, energy, and "can do" spirit that characterized the building of campuses. Today, the call has gone out for building a new kind of college–*A Learning College for the 21st Century* that will focus the full resources of the college on student learning (O'Banion, 1997). Fortunately, the demands for concerted attention to student learning are coming at a time when research and scholarship on learning are rich with findings and implications for practice.

Stunning new research on the brain by neuroscientists is adding a new dimension to our knowledge about learning that reinforces our previously tentative conclusions from cognitive psychology. This research provides growing evidence that **learning is about making connections**–whether the connections are established by firing synapses in the brain, the "ah ha" experience of seeing the connection between two formerly isolated concepts, or the satisfaction of seeing the connection between an abstraction and a "hands-on" concrete application.

Almost suddenly, it seems, the hand-wringing of the past several decades over the mediocre, and often shockingly inadequate, learning in the schools has spawned a profusion of innovative approaches to teaching and learning aimed at assuring that

students are actively making the connections that constitute learning. Many colleges are experimenting with learning communities that call for making connections with the ideas and challenges of peers. New programs in service-learning and workforce preparation, as well as new approaches to problem-based learning and research-based learning, call for making connections between knowledge and its applications. Interdisciplinary courses, writing across the curriculum, and team teaching call for making connections across the disciplines. New technologies are connecting people with others and with powerful new sources of knowledge. The common denominator in this current rash of innovations is *making connections*, and that basic concept has strong support in research and is, therefore, not likely to be just one more passing fad.

The old image of the classroom with a clear separation–an actual physical dividing line–between the teacher's podium or desk and row upon row of students aligned to prevent communication with one another, is giving way to small groups of interacting students and teams of students and teachers working together on common problems.

To what should we attribute this profound change in our conception of learning and how best to produce it? Certainly research–neurological and cognitive–has played a role, as has scholarship in philosophy and epistemology. The growing diversity of the population has required greater flexibility and has engendered a certain wariness about the acceptance of culturally defined "right" answers. And surely dissatisfaction with the results of schooling, combined with the demand for better-educated workers and citizens, has forced those inside and outside the educational establishment to search for change and accountability.

This paper is mostly about what we know about learning on the eve of the twenty-first century. Using the theme, "making connections" as an imperative for learning, I want to explore the many ways in which we can help students make connections. For my purposes, knowledge about the connections of learning can be

presented in four broad categories: neurological connections, cognitive connections, social connections, and experiential connections.

Neurological Connections

Let us start with the rich imagery of neuroscientists interested in how the brain works. Research is showing that the circuitry of the brain is wired very early by neurons that spin out axons that connect with many targets to form the transmission lines that carry electrical impulses. At the end of each wire is a bulb and button unit called a synapse. When an electrical signal traveling down one neuron's axonal wire reaches the button-like ending, a chemical message crosses the gap in the synapse to connect with the bulb of a receiving cell. Sensory stimulation strengthens connections, while connections or synapses that are seldom or never used are eliminated. Scientists believe that at birth a baby's brain contains 100 billion neurons, and that "through a process that resembles Darwinian competition, the brain eliminates connections or synapses, that are seldom or never used." (Nash, 1997, p. 50). Researchers find that children who are deprived of sensory stimulation develop brains that are 20 to 30 percent smaller than normal for their age (Nash, 1997). Thus, the best advice to parents of newborns is to provide the stimulation that encourages the connections that lay down the pathways for future learning. But what about the rest of us who work with older students whose brains, for better or for worse, are already wired for learning?

At the moment, I'm afraid, there is not much more that can be said about neurological development that is helpful to teachers of adults. But one thing that researchers hasten to assure a public grasping, perhaps almost too eagerly, at ways to stimulate the brains of newborns, is that the brain keeps growing and changing throughout life; it is never too late to learn. Indeed, there is some indication that people who continue throughout life to actively stimulate the neural networks of their brains through learning are less likely to develop Alzheimer's disease than their less-engaged peers. The new book, *Magic Trees of the Mind*, which describes for

the layperson the findings of distinguished neuroanatomist Marian Diamond, advises that "the brain grows with deliberate stimulation . . . enrich your own experiences and enlarge your cerebral cortex; deprive yourself of stimulation and the brain will shrink from disuse." (Diamond & Hopson, 1998, p. x). "Use it or lose it" seems quite literally to be true when it comes to making and maintaining the connections in the brain that form the pathways for learning.

Although much remains to be learned about the continuous growth of the brain, new insights into its physical development so closely parallel the findings of cognitive science–a body of research that has been growing at a rapid pace over the last several decades–that it will be helpful to turn now to what we know about the cognitive processes of learning.

Cognitive Connections

The parallels between the neurological brain and the working mind envisioned by cognitive scientists are quite remarkable. Modern cognitive science postulates a structure of the mind known as the schema–or in plural form, schemata, since the brain develops many schemata for different topics. A schema is a cognitive structure that consists of facts, ideas, and associations organized into a meaningful system of relationships. People have schemata for events, places, procedures, and people, for instance. A person's schema for a place, such as a college, might include concepts such as location, reputation, the characteristics of the student population, the style of campus architecture, even the location of campus parking lots. Thus, the schema is an organized collection of bits of information that together build the concept of the college for each individual. When someone mentions the college, we "know" what that means, but the image brought to mind may be somewhat different for each individual.

The schema is a working structure, changing and growing throughout life. Each new event, filtered by perception into the schema, is organized and connected to the existing structure to create meaning. One of Piaget's remarkable contributions to our

understanding of learning is that children's cognitive structures are not preformed but rather are constructed as a result of their own mental activity. They quite literally "build" their own minds. No wonder we hear so much today about the necessity for "active" learning. We now know that learners must construct their own understanding through the mental activity of making connections in their own schemata. We cannot, as teachers, transfer our knowledge ready-made to them. Students remember what they understand–what they have connected in their own schemata–not necessarily what is said by the teacher.

What students can learn depends, to a larger extent than previously assumed, on what they already know. It is easier to learn something where we already have some background than it is to learn something completely new and unfamiliar. For example, advanced courses in a subject are often easier to teach and to learn than introductory courses. Cognitive theory would explain this paradox by observing that if the schema is very sparse with respect to a particular subject, connections are hard to find and to make, whereas if the schema already has a dense network of vocabulary, terms, and concepts, it is easier to make the connections that constitute learning.

This fundamental assumption about the role of prior knowledge in learning was tested in a classic experiment that compared novice and expert chess players' ability to memorize the layout of chess pieces (de Groot, 1966). Chess players of different skill levels were shown the game pieces on a chessboard for a few seconds and then asked to recall the position of the pieces. The novice players were able to place only five or six pieces correctly, but the experts could recreate nearly the whole board. However, when these players were shown the pieces placed randomly on the board (rather than positions from a real game), novices and experts performed about the same. The conclusion from this rather simple experiment is that the superior performance of experienced chess players in recalling chess positions was not due to higher IQs or to better memories, but rather to a schema for chess that enabled experienced players to associate the patterns shown with those already in memory. The point is that what one knows about

a given subject has a substantial impact on the learning process. When teachers complain that students can't read, they are pointing not only to the lack of reading skills, but also to the density of the schema for a particular subject matter. For example, I am a "better reader," in psychology than in economics because I have a well-developed schema for the terms, concepts, and even the "ways of thinking" of psychologists.

Much of traditional instruction is based on the old images of the mind as an empty vessel, in which the teacher opens the heads of students and pours in new information which "adds" to their knowledge. Thus we speak erroneously of students knowing "more" as we add to their storehouse of information. The new cognitive science rejects the notion that real learning occurs when new information simply rests on top of the existing cognitive structure. Alfred North Whitehead (1929) captured the wisdom of active learning in these words: "Beware of inert ideas–ideas that are merely received into the mind without being utilized, or tested, or thrown into fresh combinations." In the United Kingdom, researchers are likely to refer to "deep" and "surface" learning to distinguish between learning that makes the connections that lead to deeper understanding versus information which rests on the surface, inert and unassimilated (Ramsden, 1992).

While there are surely facts that must be learned in any field of study, the problem with surface learning is that when the facts fail to become rooted in the schema, they cannot be used to build knowledge, and the isolated bits of information are quickly forgotten. While some students seem to approach their entire college education with a surface approach to learning, it is probably an error to speak of surface *learners*. It is the overuse of surface *learning* that is the problem, and all students may use it from time to time. Course conditions that appear to promote surface learning include the following: a heavy workload, an excessive amount of course material, little opportunity to pursue subjects in depth, little choice of topics or methods of study, and an anxiety-provoking assessment system that rewards or tolerates regurgitation of factual information. In contrast, course conditions

that promote deeper approaches to learning include active learning methods, encouragement of student interest in the subject, opportunities for students to interact with others, and new information presented in a logical, integrated format to establish a well-structured knowledge base (Oxford Centre for Staff Development, 1992).

What these findings seem to boil down to is that deeper learning needs time to work its way into one's schemata. Students need time to talk, write, reflect, and otherwise engage in activities that help them make the material their own. However, teachers face inevitable pressure to "cover" the material, especially in introductory courses. A study at the University of Michigan showed that students whose psychology instructors omitted details about the nervous system and concentrated on fundamentals had a better grasp of the material than those who had been exposed to the full load (McKeachie, 1994, p. 279). Less is sometimes more!

Just as there is an optimal workload, cognitive theory would suggest that there is an optimal degree of organization of the material to be presented. Teachers can be too organized as well as not organized enough. If the material is to be connected into the schema, students need to do some of the work of structuring and organizing the material themselves. A super organized presentation may be perceived as something the student could not possibly accomplish and therefore something to be memorized and deposited intact on the surface. That said, it is probably more important to provide ways of organizing the material in introductory courses, where the schema is sparse and connecting linkages are few, than in advanced courses where some structure already exists and student action can make the connections that result in meaningful learning.

If we can't build knowledge structures for students by depositing neatly organized packages into their brains, can we teach them how to build their own minds? Modern theory contends that students can be taught to be strategic learners (Weinstein & Mayer, 1985). Effective learners develop and use both

cognitive and metacognitive strategies. Broadly speaking, cognitive strategies concern the *what* of learning (i.e., taking in and retrieving subject matter content), while metacognition concerns the *how* of learning (i.e., planning, monitoring, and modifying learning processes). While identifying specific strategies and classifications is far from a precise science, we can illustrate the concept of learning strategies through brief descriptions of three cognitive and three metacognitive strategies that have been discussed in the literature.

Cognitive Learning Strategies

Three basic cognitive strategies that most of us use in academic learning of all sorts are **rehearsal**, **elaboration**, and **organization** (Weinstein & Mayer, 1985). **Rehearsal strategies** are probably more common in school learning than they should be, but we all engage in strategies to help us remember lists, facts, and definitions–for example, by underlining or highlighting text, taking verbatim notes, using mnemonic devices. Cognitive psychologists would say that such activities bring the new information into working or short-term memory, but additional strategies are needed to organize and integrate the new information into long-term memory or to make the learning one's own.

Elaboration strategies help with this. They consist of paraphrasing, summarizing, creating analogies, self-quizzing, and the like. They help learners actively connect the new information with prior knowledge and develop an organizational framework for that subject area. Using analogies is an especially powerful elaboration technique because it casts the new learning in a familiar framework. The computer industry caught on quickly to helping people understand word processing by using familiar concepts such as "cut," "paste," and "edit." Because people who had been using typewriters had a well-established schema about how to edit a paper by cutting and pasting, these new computer operations became well understood and easily remembered. Of course, it does little good to explain topic B in terms of topic A if the student does not have a good grasp of topic A.

Paraphrasing is another elaboration technique that helps

students put new learning into their own words. The "Minute Paper" is, by this time, a well-known Classroom Assessment Technique (Angelo & Cross, 1993). Asking students to write, at the end of a given class period, a brief answer to the question, "What is the most important thing you learned in class today?" is helpful to the teacher in monitoring what she has taught, but it is also a powerful pedagogical tool. When students summarize or paraphrase, they are doing the work of moving surface learning deeper into the schema by making the connections that constitute meaning.

Finally, **organizational strategies** are used to construct connections and develop relationships among ideas. Outlining is an organizational strategy, as is clustering or any other activity that groups concepts into taxonomic categories with shared characteristics. Classification into categories is a major learning–and ultimately scholarly–activity in disciplines such as botany, zoology, and biology. Landscapers, for example, organize their knowledge in a wide array of categories and subcategories. Among shade-loving plants, there are annuals, shrubs, ground covers, herbs, and perennials. There are formal, woodland, and Japanese-style gardens and fall, spring, hot, and cool colors. In contrast to learning numerous isolated "bits" of information, organizing what one learns into meaningful clusters helps both memory and understanding.

Some simple Classroom Assessment Techniques (CATs) can help students organize the material of almost any subject–and not so incidentally, help the teacher assess which concepts are not well understood. In the Categorizing Grid, for example, students are presented with a grid containing two or three important categories–major concepts they have been studying–along with a scrambled list of subordinate terms, images, equations, or other items that belong in one or another of those categories (Angelo & Cross, 1993, p. 160). The task of organizing terms into clusters helps the student construct meaning.

There are many CATs and other simple devices, formal and informal, conscious and subconscious, which have been used by

learners over the years to help them retain and understand new material. Although the cognitive strategies described here are presented in linear form, there is no intention to suggest that learners start with rehearsal and move through a hierarchy to organizational strategies. Most experienced learners have a repertoire of cognitive strategies that are used when and where they help make the connections that constitute the schemata of the mind.

Metacognitive Strategies

Metacognition is sometimes referred to as the "executive function" of the mind since it monitors and directs the work of learning. Brown and her colleagues (1983) identify three metacognitive processes: **planning**, **monitoring**, and **self-regulation**. Research suggests that good learners are more effective in their use of such strategies than poor learners.

Planning activities include setting goals for studying, skimming, generating questions before reading the text, and other activities that help the learner activate relevant aspects of prior knowledge to make organizing and comprehending the material easier. As a teacher, I have found it difficult to get students to plan how they are going to approach their study, but sometimes just showing a scattered learner how to be more systematic can help. Productive Study-Time Logs, for example, calls for students to keep thumbnail records of how much time they spend studying for a particular class, when they study, and how productively they study at various times of the day or night (Angelo & Cross, 1993, CAT #37, pp. 300-302). Through such exercises, some students will gain valuable insights into their own study habits. Discussion and comparison with peers can also provide helpful information about the productivity of their own approaches to study.

Monitoring activities are broadly concerned with strategies to help students become more aware of their own cognitive processes. Such strategies include self-testing for comprehension, tracking attention during reading or listening, and the like. Most good learners monitor their learning as they work on assignments, study for tests, or participate in labs and other classroom activities,

but poor learners seem to go through the motions of learning without much insight into the functioning of their own minds.

There are some practical and simple ways to help students monitor their own learning as it is taking place. Teachers might, for example, give occasional brief ungraded quizzes, with the sole intention of informing students of how well they understand the subject matter. Or a teacher might conduct a Punctuated Lecture, (CAT #38, pp. 303-306) by stopping a presentation to ask students to reflect on what they were doing during the presentation and how their behavior while listening may have helped or hindered their understanding. A Diagnostic Learning Log (CAT #40, pp. 311-315) is another example of a monitoring strategy. It is a type of academic journal that is used to help students analyze the effectiveness of their learning as they go. In this technique, students are asked to write one list of points covered in a class session or assignment that they understood and a second list of points that were unclear. At regular intervals, students analyze the information they have collected on their own learning and generate possible remedies for their learning difficulties in specific classes. Monitoring activities are probably the most critical aspect of metacognition, and the necessity for lifelong learning in the twenty-first century makes monitoring strategies an essential part of any enduring education.

Self-regulation is related to monitoring. If students are monitoring their comprehension as they read, for example, they can then regulate the speed of their reading to adjust for the difficulty of the material. Similarly, if students find a consistent pattern of difficulty through their analysis of the Diagnostic Learning Log described above, they can try various solutions and remedies for regulating their learning behaviors. Self-regulating strategies are intended to improve learning by helping learners check and correct their behavior as they proceed on a learning task.

We conclude this section on the importance of cognitive connections with the observation that research and theory in the field of human cognition have been exceptionally rich and

productive in recent years. With the emphasis on assembling new information into cognitive structures of knowledge relationships, it is easy to see why the dominant learning theory today is known as constructivism. The language of constructivism is replete with vocabulary from the building trades. We construct meaning, build knowledge, and design scaffolding to move from lower to higher order concepts. Some teachers might try to hammer ideas into the resisting minds of students, but more skilled pedagogical craftsmen try to find the fit where connections are made with ease and grace. Constructivism emphasizes the role of learners in actively constructing their minds rather than passively receiving information from teachers and textbooks. There are, however, several versions of constructivism, the most prominent of which is social constructivism, which expands the focus of constructivism to include greater recognition of the role of social forces and culture in building knowledge.

Social Connections

Historically, the psychology of learning has struggled with fuzzy concepts of "learning" and "knowledge." If learning is the acquisition of knowledge, it is tempting to conceive of learning as something that goes on "inside the head" and knowledge as something that exists "outside the head" in "reality." The question for epistemologists through the ages has been, *Does the mind reflect, perceive, or create reality?*

Behaviorists who reigned supreme when I was in graduate school in the 1960s, studied only the external manifestations of learning. They contended that it was "unscientific" to study what one could not see. Thus, "mind" became the black box of S-R learning theory–the hyphen between stimulus and response. Piaget and others challenged that narrow definition of "scientific," and established the legitimacy of looking at the internal processes of cognition–inside the head–but they paid little attention initially to the context in which learning occurs.

Today's theorists are interested in the interaction between the internal processes of the mind and how the mind grasps the

external realities of knowledge. Social constructivists believe that knowledge is socially constructed and that we learn, not by accurately reproducing an objective reality, but rather through the social process of constructing knowledge through negotiation and agreement among knowledgeable peers. Jerome Bruner (1990) and others (Vygotsky, 1978; Greeno, 1989; Bruffee, 1993) have argued that if the object of education is to achieve understanding, then we must look at how people interpret their environment to make meaning. Learning is neither solely "in the head," nor is knowledge an exact copy in the mind of some objective external reality. Any person's understanding of reality is filtered through that individual's past experiences and understandings and through cultural interpretations and explanations. In brief, social constructivists contend that learning consists of peoples' efforts to make sense of the world around them. And the world around them–their reality, so to speak–consists of social contexts rooted in language and culture.

Social constructivism, also known as "situated cognition" because it takes into account the situation in which the learning occurs, is the perspective guiding the trend toward learning communities, collaborative learning, and other forms of learning that place students in a socially interactive environment. These environments reinforce the constructivist notions that students must construct their own knowledge. In collaborative learning, "students must talk about what they are learning, relate it to past experiences, apply it to authentic problems, collaborate with their peers, actively construct their own meaning, and incorporate the diverse perspectives of others." (Stage, Muller, Kinzie, & Simmons, 1998, p. 41). Clearly, those experiences call for substantial modification of traditional classrooms, which are steeped in traditions of teacher authority and student independence and competition. Collaborative learning is being introduced in a variety of fields and disciplines, in particular, science, mathematics, language, and the humanities, where group projects, problem solving, and critical thinking are emphasized (Stage et al., 1998).

Learning communities are a curricular form of collaborative learning, and there are a number of different models. (See Gabelnick, MacGregor, Matthews, & Smith, 1990 for an excellent summary of the five major models). In general, they involve a restructuring of the curriculum to link together courses and a cohort of students who travel the road to learning together. Learning communities are gaining in popularity in universities as well as in community colleges, for three key reasons. First, they give more coherence to the curriculum, thereby aligning it better with our growing knowledge about learning. Second, they combat the disassociation and anomie of large and impersonal institutions. Finally, they provide increased student engagement with the people and activities of the institution. Research support for the effectiveness of learning communities comes not only from the cognitive research behind constructivism, but is also reinforced by large-scale quantitative studies. These studies consistently conclude that students who have frequent contact with fellow students and faculty members in and out of class are better satisfied with their educational experience, are less likely to drop out, and perceive themselves to have learned more than students who are less involved with the people and activities of the college (Pascarella & Terenzini, 1991; Chickering & Gamson, 1987).

Learning communities may be especially important for community colleges where commuting part-time students have little opportunity to converse with fellow students and faculty over substantive matters. Because community college students have busy, time-pressured lives, extracurricular activities play, at best, a minor role in community colleges, and student involvement with the people and life of the college must necessarily come through curricular channels. Terry O'Banion considers the opportunity for students to participate in learning communities and collaborative learning so important that he terms it one of the Six Key Principles of the Learning College (O'Banion, 1997).

Many community colleges have operated learning communities for years, without necessarily calling them that. Nursing programs, for example, typically have all the characteristics of

successful learning communities–a problem-focused curriculum, emphasis on collaborative learning, a cohort of students who take classes together, and small classes with close associations between students and faculty. Introducing learning communities into a liberal arts program is more difficult and requires considerable restructuring and faculty effort. Despite these challenges, LaGuardia Community College has pioneered the learning cluster concept of learning communities by requiring their day students in the liberal arts Associate of Arts degree program to enroll in an 11-credit cluster of courses built around a common theme. The cluster size is limited to 26 students, and faculty plan the courses together to make sure that the theme is addressed by making clear connections among their disciplines (Gabelnick, et al., 1990).

It is probably safe to conclude that making social connections among faculty, peers, and colleagues will be a major innovative strategy in the coming century. First, it represents a practical implementation of the constructivist theories of learning, namely that learning must be understood as an active process of building knowledge, rather than the passive acceptance of ready-made answers. Second, learning in context is consistent with the scholarship of social constructivism, which holds that knowledge is contextual and is constructed and understood through interaction with knowledgeable peers. And finally, learning communities, collaborative learning, and similar forms of learning in socially interactive settings are supported by additional research, which shows improved student retention and satisfaction when social connections are a part of their educational experiences (Cross, 1998).

Experiential Connections

The fourth kind of connection that is critical to learning is the most ancient and probably best-accepted form of education–experiential learning. Making the connections between experience and learning is important in two ways: first is the pedagogical use of experience to improve learning, and second is the use of learning to improve performance. In the first instance, we say that "experience is the best teacher," implying that one can

learn from experience. In the second way of connecting experience and learning, we say that we want an education that is useful–one that will lead to improved performance. Students–and more broadly speaking, the American public–want an education that is "relevant," one that provides knowledge that can be used.

Experience as teacher–as a pedagogical tool–has a long and fruitful history in education. John Dewey, the father of "experiential learning" and "learning by doing," has been called "the most important public intellectual of his day," and a philosopher with unprecedented impact on society and education (Ehrlich, 1996, p. xi). Dewey proposed that learning should be a concrete experience. Students should be faced with the task of solving problems that are real to them. Teaching, therefore, should consist of applying the principles of problem solving, which he defined as follows:

> They are first that the pupil have a genuine situation of experience–that there be a continuous activity in which he is interested for its own sake; secondly, that a genuine problem develop within this situation as a stimulus to thought; third, that he possess the information and make the observations needed to deal with it; fourth, that suggested solutions occur to him which he shall be responsible for developing in an orderly way; fifth, that he have opportunity and occasion to test his ideas by application, to make their meaning clear and to discover for himself their validity. (Dewey, 1967, p. 163)

The influence of Dewey lives on in various attempts to bring experience into the classroom and has been bolstered by modern research. It is fairly common practice today for teachers to try to make the connections between learning and experience through the use of simulations, gaming, role playing, problem-based learning, case studies, and other experiential learning techniques that get students involved in something that feels less abstract and more like learning through experience. It is also fairly common to do it the other way around, starting with formal learning and then

connecting it to experience through internships, apprenticeships, cooperative education, service-learning, and the like. In both cases, we are recognizing the value of making connections between formal schooling and experience, but in both of these efforts the pattern is too often linear. In the first case, the direction starts with experience to enhance formal learning; in the second case, the direction is from formal learning to application.

What we really need for workers and citizens of the twenty-first century is people who can conduct a lifelong conversation between their own experience and learning–who can use their experience to enhance learning and their learning to enrich application. Employers insist that they need workers who can think and analyze problems on the job. This is a different skill demand from the old manufacturing format of training workers to apply knowledge gained in school to the job. Today, there are so many different jobs, and they change so rapidly, that training for specific jobs has become largely irrelevant. Employers want workers who can think, analyze problems, critique solutions, and perhaps most importantly continue to learn to do their jobs better. That will require the ability to learn from experience, to constantly reflect on what has been learned, to experiment with alternatives, and to evaluate the outcomes.

David Kolb (1984) articulates the symbiotic relationship between experience and learning in his Experiential Learning Model, which presents the interaction between learning and experience in a spiraling, four-step, repeating cycle. The model's four steps are Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation.

The learning may begin at any point in the cycle; a moment's reflection by readers of their own experiences in teaching will reveal numerous examples of the operation of Kolb's model. Almost daily, an alert teacher will have the "concrete experience" of observing a student–or maybe an entire class–having difficulty with a particular learning task. If she is motivated to learn more about that learning problem, she may "reflect" on whether or where she has seen that problem before. She may then connect it

to an "abstract concept," which she may have developed from the experience of clustering similar experiences or perhaps she has seen something in a textbook that will help to identify the problem as belonging to a cluster of similar problems. She will probably "actively experiment" with several different ways to help that student and others to follow. In the best of all possible worlds, teaching is a continuing learning experience in which the learner/teacher is constantly making connections between experience, reflection, experimentation, and evaluation. Kolb's model has been used most often in adult and continuing education, where learning may be self-directed, but it also has important messages for classroom teachers for the Learning College. Perhaps the most significant message–or at least the one that relates most closely to current research and scholarship on learning–is the role of reflection in learning. Learning occurs, not necessarily as a result of the experience itself, but as a result of reflecting on the experience and testing it against further experience and the experiences of others.

Donald Schön (1983; 1987) has written provocatively about the importance of reflection in the practice of professions such as law, architecture, education, and the social services, where the problems are fuzzy and ill defined. While his work is best known–but not often practiced–in professional education, his concepts apply equally well to any form of learning that is intended to be applied. In the practice of most careers today, it is not a matter of applying a learned answer to a clearly defined problem, but rather of analyzing the problem and seeking a solution for what is often a nonstandard situation. Schön contends that much of the learning that is relevant to practice today is not in books or in academic courses. Practitioners, he says, learn from their practice by reflecting on what they are doing while they are doing it. He calls this "reflection-in-action." He contends that practitioners construct their own body of knowledge as they go about solving the problems they meet in their practice. Teachers, therefore, should function as coaches, helping students to reflect on what they are doing.

Service-learning is an example of a pedagogical approach that

makes explicit the power of reflecting on experience. It is a form of experiential learning in which learning and service are intentionally linked; students address real problems in their communities while deepening their understanding of course content. It differs from volunteer service in that the service performed by the student must be linked to coursework. "The hyphen in service-learning is critical," writes Jacoby (1996, p. 5), "in that it symbolizes the symbiotic relationship between service and learning." Service to the local community may be a good thing and worthy in its own right, but it is not learning unless students construct their own knowledge by reflecting on the experience and connecting new learning to existing knowledge to make it their own.

Experiential learning is a powerful form of learning, incorporating an ancient practice into modern research and theories about learning. It is undergoing something of a revival in modern education, supported and enhanced by unfolding knowledge about the working of the neural brain, cognitive processes, and the reality of each learner's social environment.

Conclusion

So what can we conclude about what modern learning theory has to contribute to the twenty-first century task of building Learning Colleges? The Learning College will concentrate on helping students make the connections that constitute learning. Cognitive and neural connections are made through establishing and keeping in good repair the pathways that connect new learning to existing knowledge. Social connections are utilized to challenge thought and to engage students actively in questioning and thinking about knowledge that is rooted in the culture and language of our society. Experiential connections are necessary to assure that students conduct an active lifelong conversation between experience and learning.

All of these connections are best established in a community dedicated to the mission of producing learning. A decade ago, the Commission on the Future of Community Colleges opened the

door to the Learning College by titling their final report, *Building Communities: A Vision for a New Century*. They advised that "The term community should be defined not only as a region to be served, but also as a climate to be created" (1988). Creating a climate for learning is the challenge that lies ahead. It will require the active participation and dedication of every member of the college community, working to establish the connections that constitute learning.

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